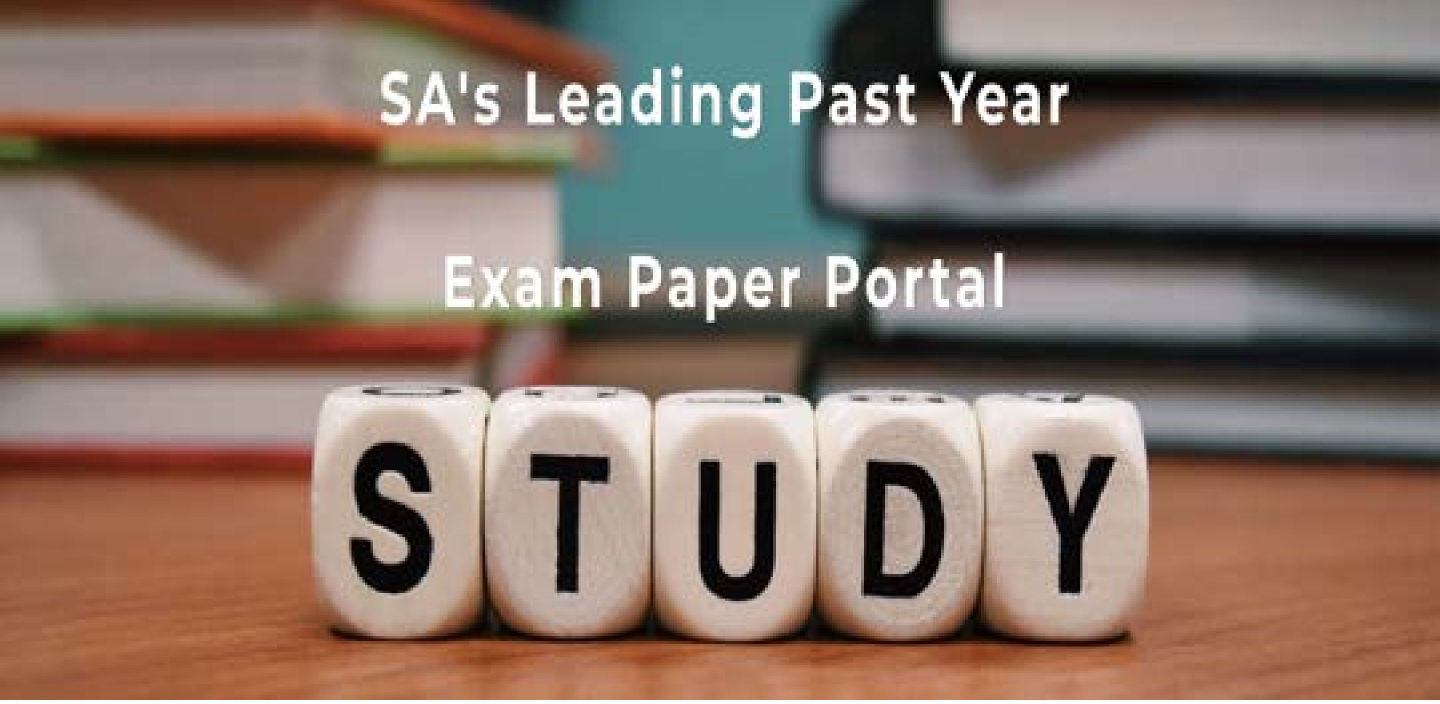
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PREPARATORY EXAMINATION

2019

MARKING GUIDELINES

PHYSICAL SCIENCES: CHEMISTRY (PAPER 2) (10842)

13 pages

QUESTION 1

1.1 A ✓✓

1.2 D ✓✓

1.3 D ✓✓

1.4 B ✓✓

1.5 D ✓✓

1.6 C ✓✓

1.7 D ✓✓

1.8 A ✓✓

1.9 C ✓✓

1.10 C ✓✓ **[20]**

QUESTION 2

2.1 2.1.1 A ✓ (1)

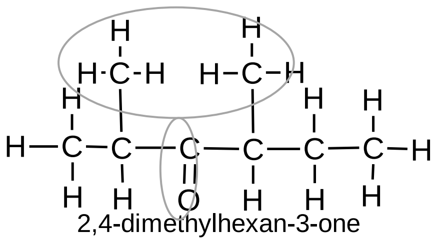
2.1.2 A ✓ (1)

2.1.3 C ✓ (1)

2.1.4 B ✓ (1)

2.1.5 D ✓ (1)

2.2



2,4-dimethylhexan-3-one

Marking guidelines:

- Correct ketone functional group ✓
- Both side chains / branches correct on correct carbon atom ✓
- Whole structure correct ✓

(3)

2.3 2,3-dichloro-3-fluorobutanal ✓✓✓

(3)
[11]

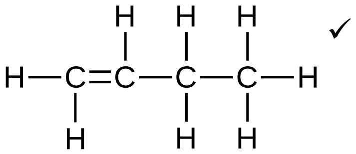
QUESTION 3

3.1 3.1.1 Esters ✓ **OR** carboxylic acids (1)

3.1.2 Ketones ✓ (1)

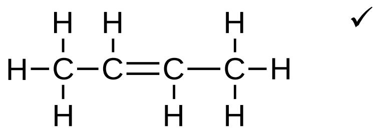
3.2 3.2.1 Chain isomers: Same molecular formula, but different types of chains ✓✓ (2)

3.2.2



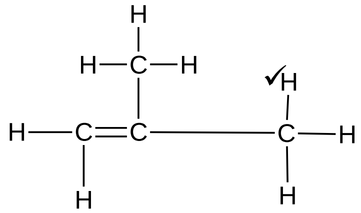
but-1-ene ✓

OR 1-butene



but-2-ene ✓

OR 2-butene



2-methylprop-1-ene ✓

OR methylpropene

OR 2-methyl-1-propene (6)

> Marking guideline:
> One mark for whole structure
> One mark for correct IUPAC name for each of the isomers

3.3 3.3.1 Butan-1-ol ✓ and pentanoic acid ✓ (2)

3.3.2 Condensation ✓ **OR** esterification (1)

3.4

If answered as: Butyl pentanoate has a higher boiling point than butyl butanoate.	If answered as: Butyl butanoate has a lower boiling point than butyl pentanoate.
Both esters have the same type of intermolecular forces (London forces). ✓ Butyl pentanoate has a longer chain therefore stronger forces between the molecules. ✓ More energy is required to overcome the intermolecular forces between butyl pentanoate ✓ therefore the boiling point is higher.	Both esters have the same type of intermolecular forces (London forces). Butyl butanoate has a shorter chain therefore weaker intermolecular forces between the molecules. Less energy is required to overcome the intermolecular forces between butyl butanoate.

> Marking criteria
> - same intermolecular forces must be mentioned. Their names need not be mentioned. ✓
> - comparison chain length / molecular mass ✓
> - energy required ✓

(3)

3.5.1 *Addition polymerisation*: A reaction in which small molecules join to form very large molecules by adding on at double bonds. ✓✓
Condensation polymerisation: Molecules of two monomers with different functional groups undergo condensation reactions with the loss of small molecules, usually water. ✓✓ (4)

3.6.1 Polythene or Poliethene✓ (1)

3.6.2 Ethene ✓ (1)
[22]

QUESTION 4

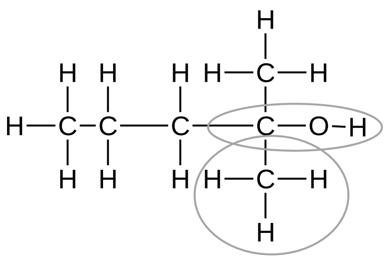
4.1 Elimination / dehydrohalogenation / dehydrobromination ✓ (1)

4.2
- heat ✓
- ✓ <u>Concentrated</u> sodium hydroxide (NaOH) / <u>Concentrated</u> potassium hydroxide (KOH) / <u>Concentrated</u> strong base

OR

Hot ethanolic concentrated sodium hydroxide / potassium hydroxide / KOH / NaOH (2)

4.3



<u>Marking guidelines:</u>
- Correct hydroxyl functional group on C-2 ✓
- Side chains / branch correct on correct carbon atom ✓
- Whole structure correct ✓
- If condensed structural formula given -1

(3)

4.4 H_2O / water ✓ (1)

4.5 Addition / Hydration ✓ (1)
[8]

QUESTION 5

5.1 To prevent loss of any solution / acid from the flask ✓

OR

To allow gas to escape

OR

To prevent any solids / liquids getting in / out

OR

To prevent spurting

NOTE: Answer must not be given in terms of preventing evaporation or condensation. (1)

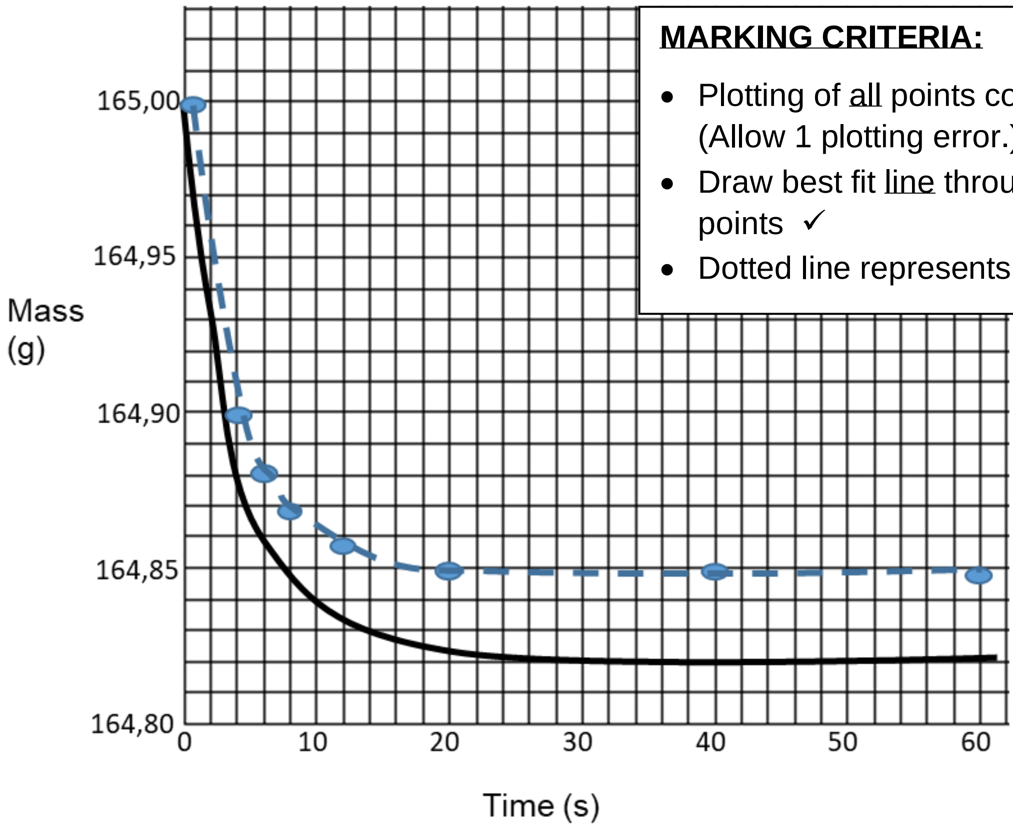
5.2 $\textit{Reaction rate} = \dfrac{\text{change in mass}}{\text{change in time}} = \dfrac{164{,}84 - 165{,}00}{10{,}0 - 0}$ ✓ ✓ $= -0{,}016\ g{\cdot}s^{-1}$ ✓

Accept positive sign or no sign in the answer.

(Negative value indicates loss in mass during reaction.) (3)

5.3.1

Graph of mass versus time



MARKING CRITERIA:

- Plotting of all points correctly ✓✓ (Allow 1 plotting error.)
- Draw best fit line through the plotted points ✓
- Dotted line represents new line.

(3)

5.3.3 The reaction will be faster. ✓
Increasing the temperature, increases the kinetic energy so that more particles have kinetic energy that is higher than the activation energy. ✓
More collisions with correct orientation ✓
More successful or effective collisions per unit time take place. ✓ (4)

5.4.1 2 ✓ (1)

5.4.2 State of division changed – Size of the zinc particles increased / surface area increased – originally lumps were used. ✓
Exp 1 powder and exp 2 lumps
Accept: removed catalyst. (1)

5.4.3 0,5 g / half of the amount as in experiment 1. ✓ (1)
[14]

QUESTION 6

6.1 A catalyst was used in the experiment that produced the graph for experiment C. ✓ (1)

6.2 The concentration of the products in both graphs at equilibrium are the same and the concentration of the reactants at equilibrium are the same, ✓ but equilibrium was reached faster in Experiment C than in Experiment A. ✓
OR
Equilibrium concentration is the same, equilibrium was not disturbed.
OR
Accept:
A catalyst was added and the rate of both forward and reverse reactions were increased. (2)

6.3 EXOTHERMIC ✓ (1)

6.4 – negative marking from QUESTION 6.3
In experiment C the concentration of the reactants is higher than the concentration of the reactants in Experiment A when equilibrium is established. ✓
∴ The reverse reaction is favoured, ✓
Endothermic reaction is favoured when the temperature is increased. ✓
Therefore reverse reaction is endothermic OR the forward reaction is exothermic. (3)

6.5 Use the data given to calculate the equilibrium constant at 500^{o} C.

	$H_2(g)$	$I_2(g)$	$2HI(g)$
Initial mol	0,5	0,5	0
Change in mol	-0,2	-0,2	0,4 ✓
Mol at equilibrium	0,3 ✓	0,3	0,4 ratio used ✓
Concentration at equilibrium	0,3	0,3	0,4

$K_c = \frac{[HI]^2}{[H_2][I_2]}$ ✓

$= \frac{(0,4)^2}{(0,3)(0,3)}$ ✓ (positive marking)

= 1,78 ✓

MARKING CRITERIA:
- Change in mol of HI ✓
- Using ratio 1:1:2 ✓
- Addition and subtraction to get the correct mol at equilibrium / concentration at equilibrium ✓
- Correct K_c expression ✓
- Correct substitution of concentration at equilibrium values from this table✓
- Correct final answer ✓

No Kc expression, correct substitution Max ⅚

Wrong Kc expression Max 3/6

(6)

OPTION 2

Concentration of I_2 at equilibrium is 0,3 mol.dm^{-3}.

c (I_2) initial = $\frac{n}{V}$ = $\frac{0,5}{1}$ = 0,5 mol·dm^{-3} and c (H_2) initial = $\frac{n}{V}$ = $\frac{0,5}{1}$ = 0,5 mol·dm^{-3}

	H_2(g)	I_2(g)	2HI(g)
Initial concentration	0,5	0,5	0
Change in concentration	-0,2	-0,2	0,4 ✓
concentration at equilibrium	0,3 ✓	0,3	0,4 ratio used ✓

Kc = $\frac{[HI]^2}{[H_2][I_2]}$ ✓

= $\frac{(0,4)^2}{(0,3)(0,3)}$ ✓ (positive marking)

= 1,78 ✓

No Kc expression, correct substitution Max ⅚

Wrong Kc expression Max 3/6

(6)

6.6 Lower than ✓ positive marking from QUESTION 6.3.
answer would then be: higher than (1)

6.7 +

Kc = $\frac{[HI]^2}{[H_2][I_2]}$

= $\frac{(0,38)^2}{(0,3)(0,3)}$ (re-calculate equilibrium concentrations)

<u>Note</u>: may use calculation or use explanation.

= 1,6

The [product] is smaller and the [reactant] is higher at the higher temperature. ✓

This results in a lower Kc value at a higher temperature. ✓

Or

Equilibrium is to the left and reverse reaction is favoured. (2)

[16]

QUESTION 7

7.1 Temperature = 25^{o} C / 298 K ✓
Pressure = 101,3 kPa / 1,013 x 10^{5} / 1 atm) ✓
$[Cl^{-}]$ = 1 mol·dm^{-3} ✓ (3)

7.2

7.2.1 $Mn \rightarrow Mn^{2+} + 2e^{-}$ ✓✓ (2)

Marking criteria:

$Mn \leftarrow Mn^{2} + + 2^{e-}$	$\left(\frac{2}{2}\right)$
$Mn \leftarrow Mn^{2+} + 2e^{-} \rightleftharpoons Mn$	$\left(\frac{1}{2}\right)$
$Mn2+ + 2e^{-} \leftarrow Mn$	$\left(\frac{0}{2}\right)$
$Mn \rightleftharpoons Mn^{2+} + 2e^{-}$	$\left(\frac{0}{2}\right)$

Ignore if charge is omitted on electron.

If charge (+) is omitted on Mn^{2+} Max. ½

7.2.2 $Mn + Cℓ_2 \rightarrow 2Cℓ^{-} + Mn^{2+}$ (3)

Marking criteria:
✓ Reactants ✓ Products ✓ Balancing

7.3 Mn(s) / Mn^{2+}(aq)(1 mol·dm^{-3}) ✓ // $Cℓ_2$(g)(1 atm) ✓ / $Cℓ^{-}$(aq)(1 mol·dm^{-3}) / Pt ✓

NOTE:
Do not penalise if phases and conditions are not included. (3)

7.4 $MnCℓ_2$ / $Mn(NO_3)_2$ / $MnSO_4$✓ (1)

7.5 Chlorine gas ✓ **OR** $Cℓ_2$ (1)

7.6 $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ ✓
= +1,36 – (-1,18) ✓
= +2,54 V ✓

Note:
Accept any other correct formula from the data sheet.
Any other formula using unconventional abbreviations, e.g. $E_{cell} = E_{OA} - E_{RA}$
Followed by correct substitutions: Max $\frac{2}{3}$

(3)
[16]

QUESTION 8

8.1 8.1.1 P ✓ (1)

8.1.2 P is connected to the positive terminal of the battery. ✓ (1)

8.2 8.2.1 $Ni^{2+}(aq)$ ✓ Note: (aq) may be omitted. (1)

8.2.2 Q ✓ (1)

8.2.3 Q ✓ (1)

8.2.4 $Ni^{2+} + 2e^{-} \rightarrow Ni$ ✓✓

<u>Marking criteria</u>:
$Ni \leftarrow Ni^{2+} + 2^{e-}$ $\left(\frac{2}{2}\right)$
$Ni^{2+} + 2e^{-} \rightleftharpoons Ni$ $\left(\frac{1}{2}\right)$
$Ni^{2+} + 2e^{-} \leftarrow Ni$ $\left(\frac{0}{2}\right)$
$Ni \rightleftharpoons Ni^{2+} + 2e^{-}$ $\left(\frac{0}{2}\right)$
Ignore if charge is omitted on electron.
If charge (+) is omitted on Ni^{2+} Max. ½

(2)

8.2.5 Remains the same ✓ (1)

8.2.6 For each mole or atom of nickel oxidised at the anode, a mole or atom of nickel is reduced at the cathode. ✓✓
Or
Rate of oxidation equals the rate of reduction. (2)

[10]

QUESTION 9

9.1.1 A substance that can act as either an acid or a base ✓✓ (2)

9.1.2 H_2O ✓ (1)

9.1.3 n = cV ✓
= (0,05)(0,036) ✓
= $1,8 \times 10^{-3}$ mol H_2SO_4 ✓
$1,8 \times 10^{-3}$ mol H_2SO_4 neutralised $1,8 \times 10^{-3}$ mol Na_2CO_3 in 25 cm^3
+ positive marking from QUESTION 9.1.3 (3)

9.1.4 m = nM ✓
= $1,8 \times 10^{-3}$ ✓ x 106 ✓
= 0,1908 g ✓

Marking criteria:
✓ formula
✓ ratio of mol
✓ 106
✓ correct answer

Also accept:

$$\frac{n_b}{n_a} = \frac{c_b V_b}{c_a V_a}$$

$$\frac{1}{1} = \frac{c_b\ 25}{0,05 \times 36}$$

$$c_b = 0,072\ mol \cdot dm^{-3}$$

$$c = \frac{m}{MV}\ ✓$$

$$✓\ 0,072 = \frac{m}{106 \times 0,025}\ ✓$$

m = 0,1908 g ✓ (4)

9.1.5 Positive marking from Question 9.1.2

Marking criteria:
✓ correct calculation of mass
✓ substitution of 5,13
✓ correct answer

$$\% Na_2CO_3 = \frac{\text{Actual mass}}{\text{Original mass}} \times 100$$

= (10)(0,0018)(106) = 1,908 g Na_2CO_3 ✓

$$= \frac{1,908}{5,13}\ ✓ \times 100$$

= 37,19 % ✓

Or

25 cm^3 has 0,1908 g✓

250 cm^3 has 10✓ x 0,1908 g = 1,908 g ✓

$$\% Na_2CO_3 = \frac{1,908}{5,13} \times 100\ ✓ = 37,19\ \%\ ✓$$

(3)

9.2 $CO_3^{2-} + H_2O \rightleftharpoons HCO_3^- + OH^-$ ✓reactants; ✓products

OR

$CO_3^{2-} + 2H_2O \rightleftharpoons H_2CO_3 + 2OH^-$ (2)

[15]

QUESTION 10

10.1 10.1.1 Total percentage mass fertiliser in the bag ✓ (1)

10.1.2 Nitrogen, ✓ phosphorous ✓ **OR** potassium (Any two) (2)

10.1.3 $\% N = \frac{2}{11} \times 40$ ✓ ✓

= 7,27 % ✓ (3)

10.2 10.2.1 Ammonium nitrate or NH_4NO_3 ✓ (1)

10.2.2 Haber process (1)

10.2.3 $(NH_4)_2SO_4$ ✓ (1)

10.2.4 Ostwald process ✓ **OR** catalytic oxidation of ammonia (1)

10.2.5 So that plants can absorb them from the soil ✓ (1)

10.2.6 Eutrophication ✓
Any given examples that apply to rivers and dams.
Note: do not accept red tide. (1)

10.2.7 Nitrogen ✓ and hydrogen ✓ (2)

10.2.8 Sulphur dioxide ✓ (1)

10.2.9 Enhance growth of crops / plants to produce more food for humans ✓
Production of fertiliser results in job creation. ✓
Selling of fertilisers stimulates the economy. ✓
(Any relevant positive impact) (3)

[18]

TOTAL: 150